

1995 Abstract Form
Scientific Presentations
OF MAGNETIC RESONANCE
RD SCIENTIFIC MEETING

AN SOCIETY FOR MAGNETIC
NCE IN MEDICINE AND BIOLOGY
ELFTH ANNUAL MEETING

Acropolis, NICE, FRANCE
August 19-25, 1995

Oral Presentation but
to present as a poster
poster but willing to make
presentation
Only
to required (available only
Oral Presentations)

CATEGORIES
S SHOULD FILL IN A
CAL CATEGORY

CATEGORY ☐
-Animal Studies
-Human White Matter
-Human Other
-Human Neuro—Clinical
Neck, Spine and Other
-vascular
-Dynamics and Flow
-vascular—Clinical
Chest
-intestinal
-urinary
Cartilage, Bone and Marrow
-Imaging
-functional MRI

SCOPY
CATEGORY ☐
-scopic Imaging Techniques
-uclear Spectroscopy
-scopic Quantitation
-Brain—White Matter & Neuro
-rative
-Brain—Stroke & Seizure
-Brain—Other
-Brain
-vascular
-inal
-skeletal
-s—Methods and Animal Models
-s—Clinical
including body fluids)

IOLOGY
CATEGORY ☒
-raphy
-quantification
-on
-onal Neuro—Methodology and Analysis
-onal Neuro—Models and Mechanisms
-copy, Non-proton Imaging and ESR
-nits and Hardware
-ils
-les
-Imaging
-Localization/Imaging
-and Artifacts
-Sequences/Techniques
-rative Imaging
-Processing
-isplay/Rendering
-st Mechanisms/MTC
-agnetic Contrast Agents
-Contrast Agents
-Bioeffects
-functional MRI

CT DEADLINE:

o later than April 11, 1995.
hts to accepted abstracts become the
the SMR. No proprietary information
held by authors.

ty of Magnetic Resonance
rd Scientific Meeting
8 Milvia Street, Suite 201
keley, CA 94704, USA

mailing abstracts from outside the
ld allow six weeks for mailing or
acts by express.

the name and complete
dress of the first author.

ENNETH KWONG

IGH-NMR CENTER

ing 149-1372 SE

WMA, MA 02129

U.S.A.

617-726-8790

7-726-7442

f SMR? ☒ Yes ☐ No

Use Only:

M #

Mechanism of MR Brain Signal Increase in Hyperoxia

K.K. Kwong, K.M. Donahue, L. Ostergaard, T. Shen, P.A. Bandettini, I. Wanke, J. Moore, B.R. Rosen
Massachusetts General Hospital NMR Center, Dept. of Radiology, Charlestown, MA 02129

INTRODUCTION

Brain MR signal increases have been observed on human volunteers breathing 100% O₂ (1, 2, 4). Increases were observed mainly in gray matter. To determine the hemodynamic events contributing to the signal change we performed experiments which assessed blood flow, oxygenation, and volume changes.

HYPOTHESES FOR MR SIGNAL INCREASE

Increased venous Oxyhemoglobin due to dissolved oxygen in plasma If the utilization of oxygen by tissue is partially met by dissolved oxygen in plasma, oxyhemoglobin in the venous side will increase while deoxyhemoglobin will decrease, leading to an increase of signal.

A. Villringer et al. (3) showed that infrared studies of human volunteers breathing 100% O₂ demonstrated an increase of oxyhemoglobin signal and a decrease of deoxyhemoglobin signal.

Reduced blood volume caused by 100% Oxygen breathing A decrease of blood volume and the amount of deoxyhemoglobin per voxel would lead to an enhancement of MR signal. To check this hypothesis, we injected rabbits with T2* weighted contrast agents such as iron oxide aggregates and measured signal change between breathing 100% O₂ and air.

Flow change due to the breathing of 100% O₂ Unlike CO₂, Oxygenation is not known to cause large CBF increase. In fact, Rostrup et al (4) measured a drop of through plane velocities at the internal carotid and vertebral arteries. We tested the flow properties of breathing oxygen with the use of a flow sensitive T1 weighted spin echo sequence.

METHODS

All experiments were performed on a 1.5 Tesla GE Signa clinical system retrofitted with echo planar imaging (EPI) from Advanced NMR. To measure blood volume change, iron oxide contrast agents with half life of several hours (MION and PION) were used in the O₂ breathing studies. Four New Zealand white rabbits weighing 2-3 kg were anesthetized, tracheostomized and ventilated alternately either with air and 100% O₂ or with air and 5% CO₂. T2 weighted spin echo sequence (TR=3s, TE=75ms) was used to study change in oxyhemoglobin and deoxyhemoglobin. To measure flow change, T1 weighted inversion recovery spin echo sequence (TR=3sec, TI=1sec, TE=20ms) was used. Rabbits were studied with and without contrast agents.

RESULTS

Without the use of contrast agents, both 100% O₂ and 5% CO₂ breathing demonstrated a rise of MR signal in the T2 weighted sequence. With the application of a high dose of paramagnetic contrast agent, signal always increased with breathing 100% O₂, whereas signal decreased below baseline with breathing 5% CO₂ (Fig.1).

In breathing 100% O₂, the minor increase in MR signal with T1 weighted (flow) sequence was much smaller than what was observed in the T2 weighted spin echo sequence. This differs from what is observed in functional MR studies where T1 weighted signal increases are normally larger than T2 weighted signal increases at 1.5 Tesla.

DISCUSSION and CONCLUSION

The causes of MR signal increases in the breathing of 100% O₂ have been explored. T1 weighted results suggest that flow increase is small. The constant rise of T2 weighted MR signal even at the presence of a high dose of paramagnetic contrast agent suggests there might be a drop of blood volume such that the oxyhemoglobin effect is enhanced by the reduction of T2* weighted contrast agents in the voxels. In breathing O₂, we are observing a different type of physiologic MR contrast that is likely different from that involved with brain activation induced MR signal changes. The potential of O₂ being a novel contrast agent is being explored.

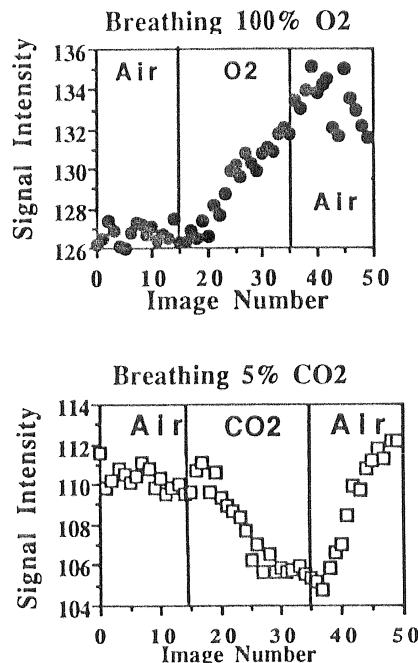


FIG. 1

MR Signal Response to O₂ and CO₂ with injection of Iron Oxide. Dosage: 20 Mg of PION per Kg

REFERENCES

- [1] Rostrup E. et al, SMRM abstracts p.275, 1994.
- [2] Kwong K. et al, Magn Reson Med 33:448, 1995
- [3] Villringer et al. personal communication. 1995.
- [4] Rostrup E. et al. NMR Biomed. 1995, in press.